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angular grains, especially near till headlands. Composition marine silt and clay. Thickness generally 1-10 m; rarely mostly quartz, but includes some feldspar and local as much as 60 m streaks and thin lenses of dark heavy minerals. Minor OUTWASH SAND AND GRAVEL AND UNDERLYING components reflect source in glacial and related deposits. LAKE DEPOSITS-Pale-yellow, yellowish-brown, red-Commonly characterized by long continuous gently dish-brown or brownish-gray, medium to coarse sand seaward sloping planar laminae; locally characterized by and pebble to cobble gravel, locally bouldery. Clasts ripple structures or by shallow channel-and-fill crosssubrounded to well rounded, chiefly of hard igneous and bedding. Boulder accumulations locally associated with metamorphic rocks; sand moderately to well sorted, deposits at till headlands. Sand frequently removed by moderately to well stratified, chiefly quartz and feldspar; winter storms exposing underlying boulder beds, till, or flat bedded, channel-and-fill crossbedded or foreset bedrock beaches in places; redeposited in summer. bedded. Surface commonly strewn with boulders and Associated dune sand is same as unit ed, but all of locally pitted with ice-block depressions. Underlying lake

ICE-CONTACT

DEPOSITS

DEPOSITS

Clasts chiefly hard igneous and metamorphic rocks.

Underlies terraces, outwash plains, valley trains, fans,

and meltwater-channel fills. Surface locally pitted with

with boulders. Mapped areas commonly include small

deposits of ice-contact sand and gravel, lacustrine

deposits, swamp deposits, peat, alluvium, eolian sand, or

deposits mostly fine to medium sand, chiefly flat bedded

locally lenticularly crossbedded, current-ripple bedded

or foreset bedded, with interbeds of massive to laminated,

locally varved, silt and clay that tend to become more

Pale-yellow, yellowish-brown, reddish-brown or brownish-

gray medium to coarse sand with sparse scattered

pebbles and local lenses of gravel. Sand moderately to

well sorted; chiefly quartz and feldspar; flat bedded,

channel-and-fill crossbedded, or foreset bedded. Under

lying lake deposits chiefly flat bedded, lenticularly

crossbedded, or ripple-bedded medium to fine sand and

laminated or varved silt and clay. Mapped chiefly in

Merrimack River valley in New Hampshire, on Cape Cod

in Massachusetts, and at the head of Narragansett Bay in

Rhode Island. Thickness of outwash sand 5-10 m;

reddish-brown, brownish-gray, or gray, fine to coarse

sand and gravel containing minor beds of silt and clay,

and local lenses or masses of till or flowtill. Poorly to well

sorted; poorly to well stratified. Inward from ice-contact

slopes, commonly characterized by distorted bedding

high-angle faults, folds, and slump or collapse structures

Bedding thin to thick; flat bedded, channel-and-fill

crossbedded, foreset bedded. Beds commonly discon-

tinuous horizontally. Textures vary laterally and vertically

Clasts range from granules to boulders, angular to wel

rounded, and are chiefly of hard igneous and meta-

morphic rocks. Smaller clasts generally of local bedrock

some large cobbles and boulders may be erratics.

Underlies kame terraces and forms complexes o

crevasse fillings, eskers, mounds, and hummocks in

valleys. Inferred to have been deposited against irregular

remnants of stagnant ice; ice-contact headward slopes o

kame terraces inferred to mark successive ice-margina

positions. Surface locally pitted with ice-block depressions,

and in places strewn with boulders. Mapped areas may

include small deposits of alluvium, outwash sand and

gravel, lake silt and clay, eolian sand, peat, or swamp

E-CONTACT DELTA SAND AND GRAVEL—Pale-yellow,

yellowish-brown, reddish-brown, brownish-gray, or gray

sand and pebble- or cobble-gravel; clasts subrounded to

stratified. Topset beds, mostly pebble and cobble gravel,

bottomset beds, flat-bedded silt and clay. Clasts chiefly

hard igneous and metamorphic rocks. Characterized by

steep headward and locally lateral ice-contact slopes

inward from which bedding commonly displays collapse

slump, and fault structures. Most ice-contact deposits are

in valleys, but some are perched on terrain above the

valley floor. They are inferred to have been deposited at

successive ice marginal positions by streams flowing from

stagnant ice into ice-marginal lakes or ponds. Thickness

olive, or pink to reddish-gray till. Locally weakly calcareous

to noncalcareous, reflecting composition of source

materials. Texture highly variable, stony sand to stony

sandy loam; locally dense, fissile silty clay with boulders

Mostly nonsorted to poorly sorted, but well sorted in

small lenses. Generally friable, lacking fissility; loose to

moderately compact. Commonly gravelly, cobbly, boul-

dery, or rubbly. Clasts angular to rounded. Rock types

reflect local bedrock, which changes markedly over

relatively short distances; lithologies chiefly granite,

pegmatite, rhyolite, granodiorite, diorite, gabbro, diabase,

basalt, gneiss, crystalline schist, slaty schist, phyllite, slate,

graywacke, argillite, quartzite, and sandstone. The sandy

till at the surface, or "upper till," locally overlies a "lower

till," not separately mapped, which is dark gray brown or

dark gray and more clayey, more compact, and less

bouldery than the "upper till." The "lower till" is commonly

present beneath "upper till" in drumlins. The "upper till"

forms ground moraine, which varies greatly in thickness

but is rarely very thick, and attenuated drift, which is very

thin and discontinuous with intervening areas of glaciated

bedrock. Both ground moraine and attenuated drift

in map unit ts except in Maine where they are mapped

separately (ts, tsr). Mapped areas locally include small

deposits of outwash sand and gravel, ice-contact sedi-

ments, lake sediments, marine sediments, alluvium, peat,

Ground moraine—Thickness generally 1.5-4 m; rarely

End moraine-Narrow to broad, well-defined ridges,

Attenuated drift—Thin, discontinuous deposits of sandy till

chiefly till, but includes local lenses of stratified sediments.

Island, New York, and on Block Island, Rhode Island.

separated by numerous or extensive bedrock outcrops,

TLL AND MARINE DEPOSITS UNDIVIDED—Till, similar to

on which are scattered erratics. Thickness generally

unit ts, but mapped areas include numerous small

or marine sand and gravel. Till generally constitutes

80-95 percent of mapped area. Commonly, marine clay

present in central parts of valleys, and marine sand and

gravel as narrow beach deposits along valley slopes.

ice-contact sand and gravel, alluvium, swamp deposits,

Ground moraine—Thickness generally 0.5-4 m; locally as

in southern Rhode Island and southeastern Massachusetts

(Cape Cod, Martha's Vineyard, and Nantucket Island).

Mapped areas locally include outwash sand and gravel,

Surface commonly bouldery. Mapped only on Fishers

swamp deposits, or eolian sand

more than 10 m

Thickness 5-15 m

widespread throughout New England; both are included

SANDY TILL-Yellowish-brown, brown to grayish-brown,

5-15 m; locally as much as 40 m

sand, and minor silt; foreset beds, sand and sparse grave

well rounded; sand moderately well to well sorted, well

deposits. Thickness 5–20 m

ICE-CONTACT SAND AND GRAVEL-Yellowish-brown,

small to large ice-block depressions, and locally strews

GLACIAL DEPOSITS

DESCRIPTION OF MAP UNITS

HOLOCENE

well sorted, medium to coarse; commonly contains

scattered shell fragments, seaweed, and, locally, organic

and inorganic trash. Sand mostly rounded but includes

Holocene age. Commonly present as narrow strips

adjacent to and immediately inland from beach sand;

cannot be separately mapped at map scale. Both beach

and dune sand deposits generally active at present.

CORRELATION OF MAP UNITS

MARINE DEPOSITS

PALUDAL EOLIAN AND EOLIAN DEPOSITS DEPOSITS GRUS

Locally, the surface sandy till is lacking. Clasts in gravel

subrounded to rounded and mostly of granite, gneiss,

and schist. Sand coarse to fine, poorly to well sorted,

locally foreset bedded, and mostly of quartz and feldspar.

Included masses of till and silty to clayey lake deposits.

On Block Island, Martha's Vineyard, and Cape Cod,

includes imbricate, ice-thrust masses of early Wisconsin

till and stratified drift. Ice-thrust masses (IT) can be shown

at map scale only on Martha's Vineyard. Sediments of

Miocene and Cretaceous age included in ice-thrust

masses at Gay Head Light on Martha's Vineyard.

Mapped areas of kame moraine include small overlying

deposits of peat, lake silt and clay, swamp deposits, and a

persistent, thin mantle of eolian sand. Thickness 5-80 m

gray, calcareous fine sand to clay. Texture may vary

markedly in short distances. Generally loose, locally very

compact; poorly sorted. Pebbly to very pebbly; locally

gravelly. Cobbles and boulders common; locally very

bouldery. Clasts chiefly erratic crystalline igneous and

metamorphic rocks. Discontinuous laterally. Mapped

only on Long Island. Mapped areas locally include small

areas of outwash gravel, ice-contact sand and gravel,

Wisconsin sandy to clayey till (tx) and early Wisconsin

clavey till (Montauk Till) on Long Island, Block Island,

and Nantucket Island. Late Wisconsin till is thin and early

Wisconsin till is at surface in much of area on Long Island.

On Block Island and Nantucket Island, early Wisconsin

till exposed only in coastal bluffs. Both tills discontinuous.

Early Wisconsin till is red, reddish-brown, brown, or gray,

calcareous clay and clay loam. Incorporated in it are

lenses and masses of lake and marine clay and silt; also

commonly interbedded with flowtill and with lake sand,

silt, and clay. Deposit compact; locally weakly stratified;

contains flow structures and shear planes locally; inferred

to have been deformed by late Wisconsin ice shove.

Generally pebble free or sparingly pebbly; rare cobbles

and boulders. Clasts chiefly erratic crystalline igneous

MARINE FOSSILIFEROUS SAND, SILT, CLAY, AND

GRAVEL (Sankaty Sand on Martha's Vineyard)—Dark-

fossiliferous marine sand; poorly to well sorted. Includes

crossbedded sand entrenched by channels as deep as

10 m. Channels are filled with kame moraine deposits

(ke) that extend laterally from the channels over the

upper unit. Upper unit involuted and ice thrust; includes

an upper, poorly sorted, silty sand containing blue

mussel shells and shell fragments, a middle ferruginous

medium to coarse sand, and a basal clean sand and

gravel containing abundant hardshell clams. Upper unit

separated from lower unit by an unconformity along

which are wind-polished stones. Lower unit includes a

bioturbated sand and a basal gravel; sand contains an

abundant hardshell molluscan fauna (many in articulated

growth position) and a serpulid bed. Lower unit overlies

sand, silt, flowtill, and stone-poor till of an earlier

glaciation considered Illinoian or older in age. Fauna in

the Sankaty Sand indicates that climate during deposition

was as warm as or slightly warmer than at present. A

U-series age of \geq 133,000 B.P. has been obtained from

shell material in the sand. Thickness ranges from from 2

reddish-brown, coarse granitic grus; overlain locally by

glacial pebbles, cobbles, and boulders from local and

distant sources. The grus is a loose aggregate of feldspar,

glacial disintegration of coarse granite along intercrystal

faces and cleavage planes. Commonly, it extends into

underlying bedrock along joint planes and around joint-

block core boulders. At one Rhode Island locality,

angular blocks of grus in the base of the overlying sandy

till, only a few centimeters from like cavities in the grus

surface, suggest that the grus was frozen when glacial

extraction of the blocks took place. Grus is developed in

coarse mafic rocks as well as in granite at a number of

small localities throughout New England, but areas

quartz, and biotite or muscovite mica resulting from pre-

patches of thin sandy till, sand, and widely scattered

GLACIATED GRANITIC GRUS-Light- to dark-brown or

to 15 m (upper and lower marine units)

PLIOCENE AND OLDER CENOZOIC

SANGAMON

than 10 m

alluvium, dune sand, or loess. Thickness 0.5-1.5 m

LATE WISCONSIN AND

EARLY WISCONSIN

txa SANDY TO CLAYEY TILL-Complex deposit of late

SANDY TO CLAYEY TILL-Yellowish-brown, brown, and

Thickness of beach sand 1-3 m; dune sand 1-5 m abundant downward. In southeastern Massachusetts and HOLOCENE AND LATE WISCONSIN on Cape Cod, the upper sand and gravel may represent delta topset outwash plains. On Cape Cod, the underlying SWAMP DEPOSIT—Dark-brown to black muck, mucky peat, lake beds locally contain carbonized wood, marine shells, peat, and organic residues mixed with fine-grained and sharks teeth, the latter reworked from underlying mineral sediment. Occurs in ice-block depressions, Cretaceous beds, and a few deep pits and well records abandoned glacial meltwater channels, and in basins show that the flat-bedded lake deposits locally overlie dammed by glacial deposits. Fibrous peat present locally large-scale deltaic foreset beds. Mapped areas commonly in ice-block depressions and small glacial lake basins include small deposits of overlying eolian sand, peat, or where it commonly overlies lake silt and clay (Ica). alluvium. Thickness of outwash sand and gravel 5-10 m; Thickness generally 1–3 m, rarely more than 5 m underlying lake deposits 5-30 m hps SALINE MARSH AND ESTUARINE PEAT AND CLAY— OUTWASH SAND AND UNDERLYING LAKE DEPOSITS-Brown or brownish-gray to gray or black peat and clay,

Commonly mixed with silt, clay, and sand. Thickness ag ALLUVIUM—Gray, locally oxide or manganese coated pebbles, cobbles, and boulders in a matrix of vellowishbrown, brown, or gray sand and some silt. Noncalcareous: poorly to well sorted, poorly to well stratified; commonly crossbedded or with cut-and-fill structure. Texture varies laterally and vertically. Upper part commonly includes subangular; mostly of igneous and metamorphic rock types. Occurs in stream channels and underlies flood plains, stream terraces, and alluvial fans. Mapped areas may include some outwash gravel or ice-contact deposits.

Thickness variable; commonly 1-5 m, but locally more

intertongued and interbedded. Dominated by Spartina

alterniflora in areas flooded by every high tide and by

Spartina patens in the higher intertidal marsh zone.

PREPARED IN COOPERATION WITH THE DEPARTMENT OF GEOLOGY AND GEOGRAPHY, UNIVERSITY OF MASSACHUSETTS,

> al ALLUVIUM—Yellowish-brown, reddish-brown, brown, olive, gray, or mottled sand and silt; locally includes minor gravel. Poorly to well sorted. Poorly to well stratified; commonly with cut-and-fill channel crossbedding. Textures vary laterally and vertically. Upper part mostly coarse to fine sand and a little silt; lower part commonly sand and gravel, in places cobble or boulder gravel. Lithologic composition reflects that of local glacial deposits and bedrock. Underlies flood plains, low stream terraces, and alluvial fans. Mapped only locally, but narrow deposits commonly present in areas mapped as outwash sand and gravel (gg) or ice-contact sand and gravel (kg). Mapped areas commonly include thin peat

and swamp deposits. Thickness variable; generally 1-5 m, but in places as thick as 10 m es EOLIAN SAND—Yellowish-brown, pale-brown, or yellowishgray medium to fine sand, locally silty. Well sorted; generally massive; locally crossbedded; weakly calcareous to noncalcareous. Sand mostly angular to rounded quartz grains, some frosted. Commonly occurs on or adjacent to areas of outwash sand and gravel (gg). Mapped only in Maine, but present on east side of Merrimack River valley in New Hampshire, on sea cliffs of Cape Cod and offshore islands in Massachusetts, and as an irregular, patchy blanket in swales and on lea slopes of irregular terrain near source areas in Rhode Island and Connecticut. Thickness 1-3 m

DUNE SAND—Pale-brown to gray well-sorted medium to coarse sand, chiefly quartz but includes some feldspar and heavy minerals; grains round to subround, commonly frosted. Locally contains a few scattered ventifacts. Forms massive irregular dunes, foredunes, or parabolic dunes. Small longitudinal and transverse dunes also present in a few places. Mapped only on Cape Cod and locally in Maine. Dune height ranges from 2 to 30 m LATE WISCONSIN

Ica LAKE SILT AND CLAY-Yellowish-brown or brown to reddish-brown, olive to bluish-gray, or gray silt and clay. Local thin beds of fine sand. Predominantly think laminated; locally varved. In places stony or interbedded with sand; locally includes bodies of till. Most deposits underlie flat, low areas or valley floors formerly occupied by glacial lakes; some adjacent to or surrounded by icecontact deposits. Mapped areas commonly include overlying eolian sand and silt, peat, swamp deposits, or alluvium. Thickness generally 1-10 m; rarely more than

Isa LAKE SAND—Pale-yellow, yellowish-brown or gray medium to coarse sand; moderately to well sorted, moderately to well stratified; mostly flat bedded; includes scattered pebbles and local lenses of pebble to cobble gravel. Sand chiefly quartz and feldspar; clasts chiefly hard igneous and metamorphic rocks. Mostly in upper sector of Merrimack River valley in New Hampshire. Thickness

MARINE SILT AND CLAY (part of Presumpscot Formation in Maine; unnamed in New Hampshire and northeastern Massachusetts; "Boston blue clay" in Boston area)-Yellowish-brown, reddish-brown, or brown, bluish-gray or dark-gray, fine silt and soft clay containing minor fine sand laminae. Locally, banding reflects colors of source bedrock. Generally calcareous: locally noncalcareous. Commonly massive and structureless; locally horizontally bedded. Intertongues with marine sand and gravel (ms) in places. Dropstones common locally; in places fossiliferous. Deposits mostly in valleys. Mapped areas include areas of till (ts) that commonly underlies the silt and clay and projects upward through it; mapped areas also

include small overlying deposits of peat, eolian sand, and alluvium. Thickness 5-30 m MARINE SAND AND GRAVEL (part of Presumpscot Formation in Maine; unnamed in New Hampshire and northeastern Massachusetts)-Pale-olive, brown, and yellowish-brown, very fine to coarse sand; massive to well stratified, evenly bedded. Locally grades into near-shore sand and gravel. Locally fossiliferous. Mapped areas include small marine ice-contact delta deposits (mkd); in places areas of the underlying till (ts) project upward through the sand, and small areas of overlying eolian sand and alluvium.

mkd MARINE ICE-CONTACT DELTA SAND AND GRAVEL-Gravish-brown, pale-blue, or pale-yellow pebble and cobble gravel and sand; well stratified, foreset bedded, moderately well sorted. Clasts well rounded; composed of hard igneous and metamorphic rocks. Topset beds chiefly gravel; foreset beds mixed sand and gravel. Mapped only in coastal New Hampshire and northeastern Massachusetts; shown by symbol in Maine. Thickness as much as 40 m 99 OUTWASH SAND AND GRAVEL—Pale-yellow, yellowish-

brown, grayish-brown, or gray, fine to coarse sand or

pebbly sand alternating with layers of granule- to cobble-

gravel and minor beds of silt; locally bouldery. Clasts

generally subrounded to well rounded. Texture varies

laterally and vertically. Crudely to well bedded; moderately

well to well sorted within beds. Commonly flat bedded or

channel-and-fill crossbedded; in places foreset bedded.

much as 10 m Attenuated drift—Thin discontinuous deposits of sandy till and local small marine deposits separated by numerous or extensive bedrock outcrops on which are scattered erratics. Mapped only in Maine. Thickness 0.5-2 m KAME MORAINE-Dark- to light-gray or pale-yellow to yellowish-brown loose sandy till several meters thick underlain by sand and gravel that locally includes masses of lake silt and clay or sandy loamy till. Forms end moraine ridges as long as 20 km and as high as 10-20 m

extensive enough to show at map scale are known only in Rhode Island. Remnant thickness 0.5-3 m SOURCES OF INFORMATION

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